

### Listing and Amendments to the Claims

This listing of claims will replace all prior versions, and listings, of claims in the application.

1. (Currently Amended) A method for transmitting a plurality of pre-coded programs having different bit rates across a fixed bandwidth channel, comprising the steps of:

generating at least two different bit rate representations of each program, said generating further comprising generating for each program a lowest bit rate representation having a peak bit rate not greater than  $C/P$  where  $C$  is the total channel capacity in time  $T$ , and  $P$  is the total number of programs;

providing control information at each of a plurality of successive time windows  $T$  for each representation of each program, the control information for each successive window indicating a bit rate and quality measure for a representation of a corresponding program; and

during each time window  $T$ , selecting a representation for each program such to maximize the quality of the selected representations while not exceeding a total available capacity for the channel;

wherein the selecting step further comprises the step of selecting a representation for each program which meets the constraint  $\sum_{p=0}^{P-1} r[p, n[p]] \leq C$  for all time windows wherein:

$C$  is the total channel capacity available in time frame  $T$ ;

$P$  is the total number of programs;

$p \in (0, P-1)$ , is the index of a particular program;

$N[p]$  is the total number of representations of program  $p$ ;

$n[p] \in (0, N[p]-1)$  is the index of a particular representation of program  $p$ ; and

$r[p, x]$  is the bit rate of representation  $x$  of program  $p$  during  $T$ .

2. (Canceled)

3. (Original) The method according to claim 1 wherein the step of providing the control information further comprises the step of establishing the peak signal-to-noise ratio (PSNR) as the quality measure embodied in the control information.

4. (Canceled)

5. (Currently Amended) The method according to claim [4] 1 further comprising the step of choosing each program's representation  $n[p] \in (0, N[P]-1)$  to maximize the quality of the program  $p$  that had the minimum quality.

6. (Original) The method according to claim 5 further comprising the steps of:

- (a) sorting the quality information for with the bit rate and quality measure monotonically increasing with an index value;
- (b) storing each bit rate increment (delta) and quality value for each index value;
- (c) beginning with a lowest index value, computing total capacity  $S$  for program representations selected thus far for such index value;
- (d) selecting a program representation at a lowest quality measure;
- (e) checking whether the bit rate increment of the selected program at the lowest quality, when added to the representations selected thus far, exceeds total channel capacity, and if not
- (f) incrementing the index value; and
- (g) repeating steps (c)-(f).

7. (Currently Amended) The method according to claim 1 wherein the selecting step further comprises the step of selecting the representation for each program such to maximize a sum

of individual program qualities by solving  $\max_{n[p]} \sum_{p=0}^{P-1} q[p, n[p]]$ ; subject to  $\sum_{p=0}^{P-1} r[p, n[p]] \leq C$

wherein:

$C$  is the total channel capacity available in time frame  $T$ ;

$P$  is the total number of programs;

$p \in (0, P-1)$ , is the index of a particular program;

$N[p]$  is the total number of representations of program  $p$ ;

$n[p] \in (0, N[p]-1)$  is the index of a particular representation of program  $p$ ;

$r[p, x]$  is the bit rate of representation  $x$  of program  $p$  during  $T$ ; and  
where  $q[p, x]$  is the quality of representation  $x$  of program  $p$  during  $T$ .

8. (Currently Amended) The method according to claim 1 wherein the selecting step further comprises the step of selecting the representation for each program ~~such~~ to maximize a product of individual program qualities by solving

$$\max_{n[p]} \prod_{p=0}^{P-1} q[p, n[p]]; \text{ subject to } \sum_{p=0}^{P-1} r[p, n[p]] \leq C$$

where,

$C$  is the total channel capacity available in time frame  $T$ ;

$P$  is the total number of programs;

$p \in (0, P-1)$ , is the index of a particular program;

$N[p]$  is the total number of representations of program  $p$ ;

$n[p] \in (0, N[p]-1)$  is the index of a particular representation of program  $p$ ;

$r[p, x]$  is the bit rate of representation  $x$  of program  $p$  during  $T$ ; and

where  $q[p, x]$  is the quality of representation  $x$  of program  $p$  during  $T$ .

9. (Currently Amended) The method according to claim **[8] 1** further comprising the step of applying a weighted average to provide different classes of service for different viewers.

10. (Currently Amended) A system for transmitting a plurality of pre-coded programs having different bit rates across a fixed bandwidth channel, comprising the steps of:

means for generating at least two different bit rate representations of each program;

means providing control information at each of a plurality of successive time windows  $T$  for each representation of each program, the control information for each successive window indicating a bit rate and quality measure for a representation of a corresponding program; and

means for selecting during each time window  $T$  a representation for each program ~~such~~ to maximize the quality of the selected representations while not exceeding a total available capacity for the channel, said selecting means generating for each program a lowest

bit rate representation having a peak bit rate not greater than  $C/P$  where  $C$  is the total channel capacity in time  $T$  and  $P$  is the total number of programs;

wherein the selecting means selects a representation for each program which meets the constraint  $\sum_{p=0}^{P-1} r[p, n[p]] \leq C$  for all time windows where:

$C$  is the total channel capacity available in time frame  $T$ ;

$P$  is the total number of programs;

$p \in (0, P-1)$ , is the index of a particular program;

$N[p]$  is the total number of representations of program  $p$ ;

$n[p] \in (0, N[p]-1)$  is the index of a particular representation of program  $p$ ; and

$r[p, x]$  is the bit rate of representation  $x$  of program  $p$  during  $T$ .

11. (Original) The system according to claim 10 wherein the generating means and control information providing means collectively comprise:

a plurality of multirate stream generators, each associated with a corresponding one of the plurality of pre-coded programs.

12. (Original) The system according to claim 10 wherein the generating means and control information providing means collectively comprise:

a multirate video encoder for encoding at least two bit rate representations of each pre-coded program.

13. (Original) The system according to claim 10 wherein the generating means and control information providing means collectively comprise:

a multirate video encoder for encoding at least two bit rate representations of each pre-coded program; and

a plurality of transport packetizers, each serving to packetize the bit rate presentations for each pre-coded program.

14. (Original) The system according to claim 10 wherein the selecting means includes a static multiplexer.

15. (Original) The system according to claim 12 wherein the selecting means comprises:  
a static multiplexer; and  
a transport packetizer for packetizing the selecting representation.

16. (Canceled)

17. (Original) The system according to claim 10 wherein control information providing means establishes quality measure in accordance with a peak signal-to-noise ratio (PSNR).

18. (Canceled)

19. (Currently Amended) The system according to claim **[18] 10** wherein the selecting means chooses each program's representation  $n[p] \in (0, N[P]-1)$  to maximize the quality of the program  $p$  that had the minimum quality.

20. (Currently Amended) The system according to claim 10 wherein the selecting means selects the representation for each program ~~such~~ to maximize a sum of individual program qualities by solving:

$$\max_{n[p]} \sum_{p=0}^{P-1} q[p, n[p]]; \text{ subject to } \sum_{p=0}^{P-1} r[p, n[p]] \leq C$$

where,

~~$C$  is the total channel capacity available in time frame  $T$ ;~~

~~$P$  is the total number of programs;~~

~~$p \in (0, P-1)$ , is the index of a particular program;~~

~~$N[p]$  is the total number of representations of program  $p$ ;~~

~~$n[p] \in (0, N[p]-1)$  is the index of a particular representation of program  $p$ ;~~

~~$r[p, x]$  is the bit rate of representation  $x$  of program  $p$  during  $T$ ; and~~

where  $q[p, x]$  is the quality of representation  $x$  of program  $p$  during  $T$ .

21. (Currently Amended) The system according to claim 10 wherein the selecting means selects the representation for each program such to maximize a product of individual program qualities by solving:

$$\max_{n[p]} \prod_{p=0}^{P-1} q[p, n[p]]; \text{ subject to } \sum_{p=0}^{P-1} r[p, n[p]] \leq C$$

where;

$C$  is the total channel capacity available in time frame  $T$ ;

$P$  is the total number of programs;

$p \in (0, P-1)$ , is the index of a particular program;

$N[p]$  is the total number of representations of program  $p$ ;

$n[p] \in (0, N[p]-1)$  is the index of a particular representation of program  $p$ ;

$r[p, x]$  is the bit rate of representation  $x$  of program  $p$  during  $T$ ; and

where  $q[p, x]$  is the quality of representation  $x$  of program  $p$  during  $T$ .

22. (Original) The system according to claim 10 wherein a weighted average is applied to provide different classes of service for different viewers.